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The effect of the electro-chart on learning in nature study in grade VIII.

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THE EFFECT OF THE ELECTRO-CHART ON LEARNING
IN NATURE STUDY IN GRADE VIII

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THE EFFECT OF THE ELECTRO-CHART
ON LEARNING IN NATURE STUDY
IN
GRADE VIII

BY
RAYMOND E. HARRIS

A THESIS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE MASTER OF SCIENCE DEGREE
MASSACHUSETTS STATE COLLEGE

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INTRODUCTION

C H A P T E R I

INTRODUCTION

(1) Major Aims of Education--The major aims of education have been written into practically every book on elementary and secondary education. The goal of education in a democracy, and the main objectives of education have been best written by the Commission on the Reorganization of Secondary Education. The Commission writes, "Education in a democracy, both within and without the school, should develop in each individual the knowledge, interests, ideals, habits, and powers whereby he will find his place and use that place to shape both himself and society toward even nobler ends."¹

The Commission regards the following as the main objectives of education: (1) Health, (2) Command of fundamental processes, (3) Worthy home-membership, (4) Vocation, (5) Citizenship, (6) Worthy use of leisure, (7) Ethical character.

Such educators as Spencer and Bobbitt wrote almost identical objectives as those written by the commission.

¹Commission on the Reorganization of Secondary Education, Cardinal Principles of Secondary Education, Bulletin, 1918, No. 35 Bureau of Education.

It is generally believed that the schools of today are fulfilling the aims of the commission to the best of their ability.

(2) Various Methods of Meeting These Aims---

The general aims of education, as conceived by educational theorists, are individual development and social efficiency. Individual development can be gained by a command of the fundamental processes, such as reading, writing, and arithmetic. Social efficiency can be gained through such aims as citizenship and ethical character. At this point the author will show how the schools attempt to meet these aims.

a. The schools provide health instruction by giving a program of physical development activities, as well as health and hygiene courses.

b. Command of fundamental processes has always been one of the major aims of education. Fundamental processes may be classed as, reading, writing, and arithmetic. Proficiency in many of these processes can be attained more readily by applying life situations to help teach these aims. In clarifying a concept in reading a text together in the classroom, the teacher and the pupils draw illustrations of that concept from

their own life experiences. Current events clubs vitalize the reading program by bringing in newspaper clippings for club discussion. The emphasis in composition writing is placed on pupils' writing of their own experiences in the outside world. The school realizes that instruction and practice must go hand in hand in order to fulfill this aim.

c. Worthy home-membership. This is an aim which must be fulfilled to make good family members. The school trains the girls and boys in the household arts and industrial arts courses. In most cases home making will eventually become a main interest in their lives; so the school must fit them for this work. In the social studies both boys and girls are taught to appreciate the home and the community.

d. Vocation. The school is the place for the pupil to explore his own capacities. In this present day of fast moving world events the modern school must offer a well balanced program of vocational guidance. The shop work should be of an exploratory nature to help the pupil find what he is best fitted for. A good academic background plus teacher guidance should help the pupil along these lines.

e. Citizenship is essential in this troubled world more than ever before. The pupil must be a worthy citizen in his community. The schools expose the students to ideals of patriotism and citizenship in many ways today, especially through history, civics, geography, economics classes, and student government.

f. Worthy use of leisure has become one of the most important objectives of education. With shorter working hours in industry the pupil must learn how to use leisure time profitably. The schools are providing more and more extra curricula activities. Clubs are now formed for music, nature, photography, drama, sports, and hobby courses in the school shops. These activities help the individual to become interested in many side activities which keep him busy and happy.

g. Ethical character is most naturally one of the main objectives in education. The school is seeking to develop pupils along these lines daily. The social activities of the school and the student participation in these activities help to build ethical character.

The modern school finds methods to meet these aims in education. The production of modern equipment,

at a reasonable price, has brought many new devices for teaching the pupil of today. Among these new devices the various forms of visual aids are receiving increased attention.

(3) Visual Education--I have already stated the main objectives of education. It is generally believed that many of these objectives may be carried out more successfully through the use of visual aids. It may be interesting to apply the use of visual aids to some of the major aims of education.

a. Health education can be taught more successfully today with some visual education to follow along with the text book. The modern school can obtain valuable moving pictures on the care of the body, including the teeth, eyes, skin, bones, etc. Many companies, including insurance offices, print very useful charts and illustrated booklets on parts of the body and the proper way to preserve them.

b. Visual aids supplement in the teaching of the fundamental processes. Reading and word study are taught in the early grades through picture studies. Arithmetic, when taught with flash cards and pegs, is an activity program. The text books are filled with illustrations, and the classroom should contain charts

and pictures to liven up the course. The moving picture and slides have now become a vital part of the program.

c. Worthy home-membership is another aim which may be taught with the help of visual education. Although not essential, the visual aids may help in fulfilling this aim. The home-making courses for girls are not complete without large charts showing meat cuts, food values, sewing hints, and other helpful aids. Excellent charts and pictures are available on first aid and sanitation. The motion picture, too, may contribute to the program.

d. Vocation, or finding one's trade or profession, usually begins in the school. The leading tool and machine factories supply the schools with excellent wall charts and pictures on the proper use and care of tools and machines. How to know the varieties of wood, sizes of nails and screws, etc. are all illustrated by admirable charts. Again the industrial films complete this program.

e. Citizenship may be taught with the help of visual aids. Social subjects are the best means for imparting information relating to the duties and privileges of citizenship. Civics and economics do rely

to a considerable extent on visual education in the preparation of graphs and charts to explain community affairs. Many educators believe that the geography texts are too encyclopedic. How difficult it would be to master the subject without the use of maps, graphs, and charts.

f. Worthy use of leisure is developed in all school programs today. More than sixty years ago Herbert Spencer prophesied that methods of increasing production would result in a greater amount of leisure.² Leisure time has done much to create hobby clubs in the schools. Many of these clubs deal with forms of visual education. Among these are photography clubs, nature clubs, and science clubs. Many of these organizations create greater interest through visual aids.

The last few paragraphs have shown that visual aids can be of real assistance in fulfilling the major aims of education. While the motion picture undoubtedly is the greatest innovation in teaching, there are other visual aids less expensive which help to arouse an interest in the school work.

(4) The Charts--Pictures are valuable in helping one to see how things look in real life. The primitive man was about the first to use visual aids. He

²Douglas, Aubrey A., Secondary Education, New York, Houghton Mifflin Company, 1927, p. 498.

drew crude pictures in the sand and carved them in stones.

Johann Comenius, a Slavic minister, composed his celebrated Orbis Sensualium Pictus or the Visible World about 1650. This was the first picture-book for children, and from his time to the present we find picture books and charts of every description to aid the student.

The modern teacher often uses charts to help in clarifying the meaning of some new device or idea. The more common types of charts are photographs, prints and drawings, mounted on a heavy cardboard. Other valuable types are bulletin boards, posters and graphs.

I have taught nature study for eight years without any classroom textbook, and for this reason alone I can appreciate the value of charts in the classroom. Using pictures and other visual aids every day encouraged me to develop the special type chart which has been used in this study.

(5) The Electro-Chart--In teaching nature study I found the children very much interested, but I had difficulty in teaching identification without the help of visual aids.

After some thought and study, I developed a chart which ran by electricity and could easily be operated by any pupil. The chart can be placed in the front of the room and is easily seen by all of the students. Hereinafter this chart will be called the "Electro-Chart."

The Electro-Chart has twenty colored pictures mounted on a piece of presswood 18" x 24". Twenty holes are punched in the card which fits on to a master electric board containing twenty more contact points. At the base of this master board are twenty more contact points, under which appear the names of the subjects which are on the charts. The pupil holds two contact points. He places one against the name of the subject and the other point to the subject. If his choice is correct, a colored light appears to show his success. If no light appears, the pupil is wrong in his identification.

The question arises as to whether the chart works to the advantage of the pupil in facilitating his identification of birds and mammals and learning their characteristics.

(6) Does the Chart Work--In order to discover whether or not the chart works successfully it is neces-

sary to develop and carry out a testing program to see what the chart can do.

I will say that the chart appears to be a novelty, and probably is, but it provides an activity program while the pupil tries to identify these subjects. One may say that the pupil is learning while playing. How much the pupil is really learning remains to be proven.

The problem of this thesis asks, "Do pupils learn to identify birds and mammals as well by the Electro-Chart as by the lecture method?" This is the question which the author will attempt to answer.

REVIEW OF LITERATURE

C H A P T E R I I

REVIEW OF LITERATURE

When one is thinking of visual education, he quite naturally thinks of pictures. Motion pictures and still pictures play an important role in educating the youth of today. The value of pictures in a text-book was realized as early as 1657. This was many years before anyone ever dreamed of moving pictures.

(1) John Amos Comenius--The most eminent educator of the seventeenth century was John Amos Comenius.³ He was born in Moravia in 1592. In 1641 he was invited to England by Parliament, to assist in reforming the system of public instruction but went to Sweden instead because of the English civil war. In Sweden, he drew up a plan for the organization of schools. He next went to Hungary for a similar purpose. Here, in 1657, he composed his celebrated Orbis Sensualism Pictus or the Visible World, the first picture-book for children.⁴ This book was an educational classic. For a century, it was the most popular text-book in Europe, and remained the favorite with young and old.

Comenius' theory was that the teaching of words

³The Orbis Pictus of John Amos Comenius, C. W. Bardeen, Publisher, 1887, p. vi.

⁴New Standard Encyclopedia, Funk and Wagnalls Company, New York, 1931, p. 185.

and things must go together, hand in hand.⁵ It is quite interesting to read the author's preface and note some of his comments on the Orbis Pictus.

- a. "It is apparent that children (even from their infancy almost) are delighted with pictures, and willingly please their eyes with these lights."
- b. "This same little book will serve to stir up the attention, which is to be fastened upon things, and even to be sharpened more and more: which is also a great matter."
- c. "Children being won hereunto, and drawn over with this way of heeding, may be furnished with the knowledge of the prime things that are in the world, by sport and merry pastime."⁶

In the early seventeenth century educators could see the value of adding pictures to a text-book. This form of visual education helped the pupil visualize that which he was reading. This is as true today as it was in the seventeenth century. Evidence of this is found in the many pictures and illustrations in the text-books used in our schools.

⁵The Orbis Pictus of John Amos Comenius, C. W. Bardeen, Publisher, 1887, p. vii.

⁶The Orbis Pictus of John Amos Comenius, C. W. Bardeen, Publisher, 1887, p. xv.

(2) Early Prints--The early pictures were engraved on wooden blocks, and from these blocks the prints were made for the books. Copper plates replaced the wooden blocks as the art progressed. But the process was still a laborious one until, in 1824, Jacques Mande Daguerre discovered that certain silver salts were sensitive to light, and from his experiments came the daguerreotype style of pictures.⁷ This was the real beginning of photography, and from this art we are able to illustrate our books with ease today.

(3) Visual Education in General--As I have already shown by the work of Comenius, visual aids is not a new development. In the prehistoric times the people wrote mostly by pictures. Drawings have been found in caves in France made by Cro-Magnon many thousands of years ago.⁸ A study of the history of education has shown that such famous men as Froebel, Rousseau, Agassiz and Pestalozzi realized the importance of visual aids.

A check on the earlier types of visual aids led the author to search for ideas from the more modern writers on this subject. Heiss, Obourn, and Hoffman state the following general principles as general guides

⁷Pendray, G. Edward, Men, Mirrors, and Stars, Funk and Wagnalls, 1935, p. 208.

⁸Heiss, Obourn, Hoffman, Modern Methods and Materials for Teaching Science, The Macmillan Co., New York, 1940, p. 148.

to the use of visual materials.⁹

- a. "The exposure of pupils to visual aids will not in itself guarantee successful teaching. Visual aids must be adapted to the intellectual maturity of the pupils and to the nature and extent of the pupil's previous experiences."
- b. "Visual aids are not meant to be a substitute for oral and written methods of gaining knowledge. They are to be used to supplement and enrich other methods of learning."
- c. "Visual instruction in the classroom should not be confused with entertainment. Visual aids are not meant to eliminate work or thought. They should be used to make work more interesting and more meaningful and to stimulate pupils to greater activity and thinking."
- d. "Visual aids vary in their effectiveness in direct proportion to their degree of reality."

(4) Charts and Still Pictures--Whether used in school or encountered at home, at the theatre, or elsewhere in the environment, pictures, sound or silent,

⁹Heiss, Obourn, Hoffman, Modern Methods and Materials for Teaching Science, The Macmillan Co., New York, 1940, pp. 148, 149.

motion, or still, are for the child a means to at least the following ends:¹⁰

- a. Getting facts, or as a direct source of information.
- b. Developing concepts, or a broader sensory development.
- c. Promoting thought.
- d. Developing attitudes and interests.
- e. Socialization.

In most cases pictures are certainly a direct source of information. If one wanted to check on the true color and shape of a bird, animal, flower, or any other specimen, he would refer to a good picture book or chart, if a specimen were not available. Most of the educators agree that the films offered for school use are informational in nature. Very few are actually for entertainment. Even the early picture books were illustrated to make reading easier to understand.

Still pictures and charts are of real value in developing concepts. Mental impressions are made when one studies an accurate picture of any subject. One can read a book which is not illustrated, and still be in doubt after reading a fine description. This is

¹⁰Dale, Dunn, Heban, Schneider, Motion Pictures in Education, H. W. Wilson Co., New York, 1938, p. 113.

especially true in the sciences. The school dictionary would not be complete without pictures to show the words described therein. We are living in a world of pictures today, and their value cannot be questioned.

Such pictures help to promote thought. One can read a book describing life, machines, the heavenly bodies, or buildings, but he can think more clearly with an illustration on hand. Imagine a book telling how to recognize ten or twenty different birds, animals, or flowers without any illustrations. How dull a course in astronomy would be without charts and pictures to show the comparative sizes of the planets. One would have a real problem today if he attempted to operate a machine just by reading about it.

Charts and pictures help the machinist with their clear descriptions. Blue prints tell the machinist and the builder how to complete their work. They show them how the job should look before it is even started. The home, the school, and the factory all depend on pictures today for recreation, for assistance in completing a job, or helping to visualize a written description.

(5) Colored Pictures--Some controlled experimental investigations have been made on the use of pic-

tures and other concrete teaching aids with children. Mac Lean reported some data on the use of color in pictures.¹¹ "For portraying distances, enhancing contrasts, and conveying impressions of sunlight and warmth, the use of color was reported to be superior to black and white representation." On the other hand he reported that, "the use of color seems to have less value when the purpose is to show architectural and engineering details."

While on the subject of colored pictures one cannot overlook the general conclusions made by Goodykoontz as they relate to the effect of pictures in motivating reading.¹²

1. Children like books that have at least a quarter of the book given to pictures.
2. Children like full page or fairly large pictures.
3. Children prefer strong color.
4. Bold color groups with few but striking details are better than many details.
5. Realistic pictures are preferable to conventionalized pictures.
6. Action, humor, and a story are favorite picture types.

¹¹Mac Lean, W. P., "A Comparison of Colored and Uncolored Pictures," Educational Screen, September 1930, p. 196.

¹²Goodykoontz, Bess, "The Relation of Pictures to Reading Comprehension," Elementary English Review, April 1936, p. 125.

7. Young children like a broader range of picture subject matter than they usually receive.
8. Young people do not care especially for pictures of child activities.
9. Older children like pictures related to in-school and informational interests.

(6) Trends In The Schools Today--Teachers of science, including the natural and physical sciences, have, according to available articles, used the motion pictures in most systematic fashion. The reason is, apparantly, that science has always been taught by the laboratory method, and the motion picture, lantern slide, and charts are substitutes for an actual demonstration. Many other courses in the curriculum are now finding the visual aids most helpful. Geography, civics, history, and shop work now find the visual aids to be of real assistance in balancing the program.

Secondary school teachers use motion pictures and other visual aids to serve the following purposes:¹³

1. As background for a unit.
2. To stimulate interest or develop an appreciation.
3. As actual teaching aid, or direct source of information.

¹³Dale, Dunn, Hoban, Schneider, Motion Pictures In Education, The H. W. Wilson Co., New York, 1938, p. 183.

4. To sensitize students to social problems.
5. As aids to pupil activity.
6. As review of a unit.
7. For testing.

(7) A Summary On Still Pictures, Charts and Designed Materials--Many persons think of moving pictures as the primary visual aid. Many other valuable visual aids include maps, graphs, charts, pictures, excursions, models, lantern slides, filmstrips, etc. To be sure, teachers do not always use these sources of help, but, nevertheless, they exist. For example Heer states: "Our text-books are filled with pictures, yet comparatively few teachers use them effectively." Again, "Pictures which are very valuable in teaching can be found in our daily press, in travel literature, in magazines, and in advertisements. Yet relatively few of our teachers appreciate their possibilities and still a lesser number preserve, classify, and file them as aids to more effective teaching."¹⁴

Flat pictures or still pictures are the oldest and most common type of visual aids, but by no means the most modern. This particular aid is the most abundant and can be made more effective by mounting the pictures

¹⁴A. L. Heer, "Using Visual Aids in Teacher Training," Educational Screen, April 1939, p. 118.

on paper, presswood, or some other firm board so as to make it a permanent visual aid.

Specimens and models serve as ideal visual aids. Specimens such as stuffed birds, dried insects, and pressed flowers are ideal. Models serve as a great aid when it is too difficult to get a true specimen. Such models are cast in plaster of Paris and Keene's cement.

Designed material such as wall charts are valuable. The Audubon series of bird charts is an excellent example of this type. Biology, history, and geography classes often depend on this particular visual aid. In many of these cases colored charts add to the effectiveness. Included in the group of designed materials is the graph which is used so widely today.

"The school journey or excursion is any school exercise designed to provide complete sensory experience with things and phenomena which cannot be brought into the classroom. It involves the taking of pupils to places where the subject matter of instruction may be studied first-hand. The school journey is the most real and most concrete of all visual-aid techniques because it brings the pupil into direct contact with objects and

phenomena in their natural setting."¹⁵

Other important visual aids of more technical nature are the microscope, the camera, the telescope, and the motion picture projector. The motion picture will be discussed in detail in the following paragraphs.

(8) Motion Pictures--Among visual aids, the motion picture occupies a prominent place in the schools today. The motion picture in school life is generally considered an aid in achieving three ends. These three ends are well stated by Ruth Livermon:¹⁶

1. Entertainment
2. Appreciation
3. Instruction

It is in the third group that the school most naturally places its greatest emphasis. It is a generally accepted fact that motion pictures are an aid in the teaching of factual information. It is also generally conceded that if films are properly used in the classroom they will result in a saving of time and energy in teaching informational subject matter of the usual course of study. Several testing programs have been carried out to prove the value of the motion picture in the classroom. These will be treated later.

¹⁵Heiss, Obourn, Hoffman, Modern Methods and Materials For Teaching Science, The Macmillan Co., New York, 1940, p. 151.

¹⁶Ruth Livermon, "The Use of Motion Pictures in an Elementary School," Educational Screen, November 1938, p. 285.

One must admit, however, that the communication of information is only one of the many aims of instruction in any subject and in any classroom. The progressive teacher wants to create clarity of thinking, desirable social attitudes, awareness of problems, appreciation, and the like. "Much less work has been done in the measurement of the so-called 'intangible' results of the use of films than in the measurement of factual information," states Lloyd L. Ramseyer.¹⁷

Many who have made a study of the present day problems in visual aids have noticed that teachers are inclined to use that type of visual aid which happens to be most readily available without giving much consideration as to its ability to do work for which it was selected.

For example--Films are used when static aids such as the model, map, slide or chart might better have been chosen. Materials incapable of showing motion, have been employed to teach problems in which motion was the most important factor being considered. In vitalizing the program, the teacher should keep in mind the objectives to be accomplished with the visual aids and accordingly pick the one which best fits the need.

¹⁷Lloyd L. Ramseyer, "Measuring Intangible Effects Of Motion Pictures," Educational Screen, September 1939, p. 237.

(9) Experiments and Testing Programs Conducted

With Visual Aids--One of the best known studies is found in the book by Phillip Justin Rulon.¹⁸ The experiment represents an attempt to evaluate numerically the educational effectiveness of the sound motion picture in the teaching of a school subject. The experiment was performed with ninth grades and the subject was General Science.

The experiment consisted in presenting General Science instructional material in two different ways and comparing the amounts of learning resulting therefrom. In terms of student achievement the results indicated that the teaching technique employing the motion picture film was 20.5 per cent more effective from the instructional standpoint than was the usual unaided presentation.

In terms of retention, the tests showed that the retained gain of the Film Group was 38.5 per cent greater than that of the Control Group.

Another interesting experiment with visual aids was carried on by Wilber Emmert, Director of Visual Education, State Teachers College, Indiana, Pennsylvania.¹⁹ His experiment was to determine the effect-

¹⁸ Phillip Justin Rulon, The Sound Motion Picture In Science Teaching, Harvard University Press, Cambridge, 1933.

¹⁹ Wilber Emmert, "In and For the Classroom," Educational Screen, December 1939.

iveness of vocabulary teaching which employs various visual aids, as compared to instruction which makes use of few or no visual aids. A pre-test and final test were given in September and December respectively.

The visual aids method was much more successful. The Visual Aids Section scored a total net gain of 130 points more than the net gain scored by the Non-Visual Aids Group, or an average of 9 plus points higher per child. Figured on a per-cent basis, the use of visual aids proved 22.2 per cent more effectual on the average than teaching done with little use of visual aids.

In reviewing the results of these two experiments one must admit there is some real value obtained from visual aids in the teaching program.

OUTLINE OF PROBLEM

CHAPTER III

OUTLINE OF PROBLEM

The problem which this study investigates was called forth by the fact that the author has invented and patented a device for teaching Nature Study, which he has called an Electro-Chart (See Appendix). The question arose as to whether or not this device was efficient in teaching various phases of the subject.

(1) The Problem--The problem is to ascertain whether pupils learn to identify birds and mammals as well by the Electro-Chart as by the lecture method.

(2) The Subjects for the Problem--The subjects for this problem were three classes of pupils in grade VIII in the Agawam Junior High School. The school is a six-year unit including grades seven through twelve, and has an enrollment of about 800 pupils. The building has twenty-six classrooms, two gymnasiums, shops, laboratory units, household-arts rooms, an agricultural department, and an auditorium with a large moving picture booth.

(3) The Materials Used for the Problem--The following materials were used for the problem:

a. The Electro-Chart (See Appendix).

- b. Ordinary charts and pictures from bird and animal societies.
- c. Reference books. The reference books used were nature books recommended for eighth grade work. Many of the bird and mammal books contained life-like pictures in true color.
- d. Teacher-prepared units. (See Appendix)
- e. Teacher-made test for evaluation of growth. (See Appendix)

(4) Procedure--The following procedure was used.

- a. One group was designated as a control group, and the other two classes were used as experimental groups.
- b. The pupils in the control group were paired with the pupils in the experimental group on the basis of:
 - 1. Intelligence quotient.
 - 2. Chronological age.
 - 3. School average.
- c. Next came the development of the units of material to be taught to all groups. The author developed mimeographed sheets con-

taining information about the birds and mammals to be studied. These sheets were given to each member of the groups after certain individuals in the class had given special reports on the birds and mammals. The units of material were used as a basis for the final examination (See Appendix).

- d. A pre-test was given on birds and mammals to the three groups. The object of these tests was to enable the author to check the gain later. The tests were of the objective type (See Appendix).
- e. Designated units were taught for three months. The bird study was carried on for eight weeks. This included special reports, teacher unit study, chart work, and picture study. The control group had no chart work. The mammal study was carried on in the same manner for four weeks.
- f. The final test in nature study was then given to the three groups. The final test which was the same as the pre-test was given after designated units had been taught

as planned.

g. The gains of the control and experimental groups were compared.

h. The reaction of teachers and students to the Electro-Chart was then obtained.

The results of the various phases of the study will be found in the following chapters.

THE RESULTS OF GROUPING

C H A P T E R I V

THE RESULTS OF GROUPING

The major necessity of an experimental study such as this is that all possible elements in the situation being investigated be controlled, except for the one element under investigation. In the study of Nature presumably many elements may appear to condition the success of pupils. Among these may be listed the ability of the pupils as shown by the intelligence quotient, their maturity as shown by chronological age, and their background in science. Other items which may contribute are: (1) time of day (2) size of class (3) ability of teacher, etc. It becomes necessary, therefore, to show that these items have all been adequately controlled so that any additional increment of gain will be due to the one element--The Electro-Chart--under investigation. Much of this control was obtained by means of pairing the pupils on the basis of the various items. The results are shown below.

(1) Results of I. Q. Groupings--It would appear evident that success in Nature Study is conditioned in part by intelligence. Was the matter of intelligence adequately controlled? The results of the pairing is shown in Table I.

TABLE I

The I. Q.'s of the control and experimental groups used in the experiment.

I. Q.'s	Control	Experimental
120	3	2
115	0	1
110	5	5
105	8	7
100	9	10
95	4	4
Mean	107.0	106.7
Standard Deviation	7.0	6.75

Table I shows that the matter of intelligence was adequately controlled in the experiment. The difference in the Mean I. Q. for the two groups being only .3. The difference in the Standard Deviation is only .25.

(2) Results of School Average Groupings--The matter of school averages was considered for this experiment. The results of Table II will show that the school averages of the two groups was well controlled.

TABLE II

The School Averages of the control and experimental groups used in the experiment.

School Averages	Control	Experimental
85	5	5
80	8	12
75	12	9
70	3	2
65	0	0
60	1	1
Mean	79.5	80.4
Standard Deviation	6.05	5.0

Table II shows the difference in Mean School Average to be only .9 in favor of the experimental group. The difference in Standard Deviation is 1.05 for the two groups. In School Average the control group is more heterogeneous. That is, the Standard Deviation shows a wider range of scores for the middle two-thirds of the class.

(3) Results of Age Groupings--In order to have both groups equal in every respect possible, the author found it necessary to control the age element. Table III shows the results of the pairing for age distribution.

TABLE III

The Age Distribution of the control and experimental groups used in the experiment.

Ages	Control	Experimental
15	2	1
14-6	2	2
14	5	4
13-6	6	10
13	8	7
12-6	6	4
12	0	1
Mean	13.8	13.8
Standard Deviation	8.7	7.8

Table III shows that the Mean Age was identical for the two groups used in the experiment. Again, the control group was slightly more heterogeneous.

(4) Control of Various Other Factors--The preceding tables show that such elements as intelligence quotient, chronological age, and school average were well controlled for this experiment. Other elements considered will be discussed briefly.

The teacher was the same for both the control and experimental groups. This person has been the regular Nature Study teacher for several years in the eighth grade.

The materials used were the same for both groups, except for the visual aid used by the experimental group. The visual aid used was the Electro-Chart. All of the groups used the same teacher prepared units and reference books, and carried on the same type of class discussion.

The classes were about equal in size. This made teaching conditions about the same for the teacher for each group. On this same basis the learning conditions were about equal for all groups. There were 34 pupils in the control group with 35 and 32 pupils in the experimental groups.

Another element considered was the time of day the classes were held. All three groups met for two one hour periods each week. The schedule as shown below states the days and hours each group met for Nature Study.

<u>Group</u>	<u>Monday</u>	<u>Wednesday</u>	<u>Friday</u>
Experimental I	9-10		10-11
Experimental II	10-11	1-2	
Control	11-12		1-2

It appears from this table that all of the groups were treated equally as far as time of day was concerned. There is a possibility that one experimental group was at a slight advantage as far as time of day was concerned in that it had no afternoon class.

(5) Summary of Provisions for Control--It is quite evident that provisions for control were well taken care of in this experiment. In intelligence quotients, the two groups were almost equal, and the same was true of school averages. The mean was also computed for the chronological age and found to be identical for the two groups.

Other factors under control were the teacher, materials used, number of pupils in each group, and time of day. As the author has already shown these elements were well controlled. The probabilities are therefore that any superior achievement on the part of any one group will be due solely to the experimental variable, that is, the Electro-Chart.

RESULTS OF STUDY

C H A P T E R V

RESULTS OF STUDY

Words can easily describe the results of such a study as made by the author, but in this case the figures are very significant. Chapter IV has shown that all possible elements in the situation were well controlled. The question now arises as to what results were obtained with the use of the visual aids. These are best shown by the following tables.

(1) Pre-test in the Bird Study--In order to find the beginning knowledge of each pupil a pre-test was given in bird study. This test was of the objective type and had 157 questions. The results of this test were tabulated so they could be compared with the mark of a final test to be given eight weeks later. The results are found in Table IV.

Table IV shows the mean of the control group to be 5.5 higher than that of the experimental group. This result would seem to give the control group a slight advantage even before the study actually started. The significance of this difference can be seen in Section III dealing with the gains made by the groups during the experiment.

TABLE IV

Results of the Bird Study pre-test showing the mean and standard deviation for both groups.

Scores	Control	Experimental
110	0	1
100	3	1
90	10	6
80	6	8
70	8	8
60	2	3
50	0	0
40	0	1
30	0	1
Mean	86.3	80.8
Standard Deviation	11.5	16

(2) Final Test in the Bird Study--The final test was the same test that was given at the beginning of this experiment. As eight weeks had elapsed the author feels that few of the questions had been remembered by the groups. This test was given to check the gain made in the eight-week study. The results for the final test on Birds are shown in Table V.

TABLE V

Results of the Bird Study final test showing the mean and standard deviation for both groups.

Scores	Control	Experimental
120	1	3
115	0	2
110	2	3
105	3	4
100	8	4
95	7	5
90	2	2
85	1	1
80	1	1
75	4	1
70	0	3
Mean	97.8	100.6
Standard Deviation	11	14.5

Table V shows the mean of the experimental group to be 2.8 higher than that of the control group in the final test. It is interesting to observe that the control group started with a higher mean than the

experimental group in the pre-test, but finished lower than the experimental group in the final test. The difference in standard deviation was also less in the final test.

(3) Gains for Bird Study--In order to check the gains made by the two groups the author subtracted the results of the pre-test from those of the final test. The results will be found in Table VI.

Table VI shows many interesting results which very definitely favor the experimental group. They show a gain in the mean of 6.85 over the control group. The critical ratio of the difference is 2.5. With a critical ratio of 2.5, the chances are 994 out of 1,000 that the difference is statistically reliable.¹

(4) Pre-test in the Mammal Study--The mammal pre-test was on the same plan as the bird pre-test. It was of the objective type and contained 142 questions.

Table VII shows the mean of the control group to be 4.2 higher than that of the experimental group. As in the case of the bird pre-test this would give the control group a slight advantage at the start of the experiment.

¹Garrett, Henry, E., Statistics in Psychology and Education pp. 132-135.

TABLE VI

Comparison of gains made by the experimental and control groups on bird study.

Gain	Control	Experimental
45	1	0
40	1	4
35	1	5
30	3	7
25	4	3
20	6	4
15	5	2
10	4	3
5	3	0
0	1	1
Mean	21.85	28.7
Standard Deviation	10.50	10.5
Standard error of means	1.9	1.9
Standard error of difference		2.7
Critical ratio of difference		2.5

(5) Final Test in Mammal Study--This test was the same as the pre-test. Four weeks were given to mammal study after the pre-test. so the author feels that

TABLE VII

Results of the Mammal Study pre-test showing the mean and standard deviation for both groups.

Scores	Control	Experimental
120	3	0
110	5	3
100	3	4
90	2	8
80	8	6
70	6	6
60	2	1
50	0	0
40	0	1
Mean	93.6	89.4
Standard Deviation	18.5	16

very few of the questions had been remembered by the groups.

Table VIII shows that the two groups were almost equal as the two means only show a difference of .4.

(6) Gains for Mammal Study--In this case the same procedure was used that had been used in the bird study.

TABLE VIII

Results of the final Mammal Study test showing the mean and standard deviation for both groups.

Scores	Control	Experimental
130	0	2
120	12	10
110	6	7
100	5	6
90	6	2
80	0	1
70	0	0
60	0	1
Mean	113.2	113.6
Standard Deviation	11	18

Table IX shows a gain of 4.9 in the mean for the experimental over the control group. This table also shows the critical ratio of the difference to be 2.1. With a critical ratio of 2.1, the chances are 98 out of 100 that the difference is statistically reliable.²

(7) Summary--Many interesting results in chapter V show the reader that the experimental group gained

²Ibid

TABLE IX

Comparison of gains made by the experimental and control groups on Mammal Study.

Gain	Control	Experimental
50	0	1
45	0	0
40	0	0
35	3	2
30	2	5
25	5	5
20	4	7
15	4	5
10	6	4
5	4	0
0	1	0
Mean	20.1	25
Standard Deviation	9.5	9
Standard error of means	1.7	1.6
Standard error of difference		2.3
Critical ratio of difference		2.1

relatively by the use of the Electro-Chart. Table IV

would give the reader the impression that the control group would average higher due to a higher mean in the bird pre-test, but in the final bird test we find the experimental group with a higher mean. In Table VI which shows the gain for the bird study groups the reader will find that the mean of the experimental group is 6.8 higher than that of the control group. The critical ratio of difference is 2.5 which is definitely in favor of the visual aids group.

In the case of the animal testing the results again favor the experimental group. The pre-test would again lead the reader to believe the control group might average higher because of the larger mean. In Table VIII we find that the experimental group has a mean only .4 higher than that of the control group, but the gains in Table IX show that the experimental group has a mean 4.9 higher than that of the control group. The critical ratio of the difference in favor of the experimental group was 2.1. While this was not as great as the critical ratio for the bird study, again it rules in favor of the experimental group.

PUPIL AND TEACHER REACTIONS
TO
THE ELECTRO-CHART

C H A P T E R V I

PUPIL AND TEACHER REACTIONS TO THE ELECTRO-CHART

In order to get the pupil's reactions to the Electro-Chart the author constructed a questionnaire which was given to the three groups using the chart. One of these groups was not included in the experiment but this would not affect their answers in any way.

Seven questions were asked which read as follows:

1. Which did you enjoy more, bird or animal study?
2. Did pictures help you in your bird and animal study?
3. Would you have enjoyed bird and animal study without pictures?
4. Which type of pictures made your work more helpful?
(If any, check your favorite).
 - a. The Audubon Bird Charts
 - b. Individual flat pictures
 - c. The Electro-Chart
5. Why did you choose a, b, or c?
6. Do you consider the Electro-Chart just a game?
7. Tell very frankly what you think of the Electro-Chart. (Either your like or dislike).

There were ninety-six students answering the questionnaire from the three groups.

(1) Results From the Questionnaire--The cumulative results from the questionnaire are shown below:

Question 1--Which did you enjoy more, bird or animal study?

Animals 68--Birds 28

Animal study followed the bird study, and for this reason was probably more in the minds of the students. The author wanted the results of this question because the testing program had shown that the student fared better in bird study.

Question 2--Did pictures help you in your bird and animal study?

Yes 95--No 1

Question 3--Would you have enjoyed your bird and animal study without pictures?

No 87--Yes 9

Question 4--Which type of pictures made your work more helpful? (If any check your favorite).

- a. The Audubon Bird Charts 12
- b. Individual Flat Pictures 8
- c. The Electro-Chart 76

Question 5--Why did you choose a, b, or c?

Listed below are some of the reasons for choosing a, b, or c.

Reasons for choosing (a) Audubon Bird Charts:

1. The birds are larger, more colorful, and easier to find.
2. The pictures show their natural surroundings.
3. The birds are more life-like.
4. The coloring is better.
5. They are more easily seen.
6. The name is given and no work is required.

Reasons for choosing (b) Flat Pictures:

1. The pictures were larger.
2. The flat pictures can be put into a notebook.
3. They give a better description.
4. They are more easily seen.
5. You can learn to identify them with your own pictures.

Reasons for choosing (c) The Electro-Chart:

1. It made the study more interesting.
2. It was fun to work.
3. It showed whether you were right or wrong.
4. By working it you learn to identify the birds and animals.
5. You can learn outside of school hours.
6. They are more easily learned.

7. It's like a game, and I like games.
8. You are able to check yourself.
9. You can hunt until you find the correct one and this helps you to remember it.
10. I like to test my skill and see how many I can get.
11. The other two are too dead, not enough activity.
12. It helps me to enjoy nature study.
13. You learn more and get more out of it.
14. I was playing a game and learning at the same time.

Question 6--Do you consider the Electro-Chart just a game?

No	66
Yes	13
A game but an educational teaching device . .	17

Question 7--Tell frankly what you think of the Electro-Chart (Either your like or dislike). Listed below are a few of the reasons why they liked the chart.

1. It was fun and at the same time helpful.
2. I liked the contests between the different rows.
3. You could test your skill.
4. It is practical for teaching students.
5. It is interesting and educational.
6. You know when you are right or wrong.

7. Learning comes easier when you do things you like to do.
8. It gives everyone a chance to identify birds and animals by himself.
9. It holds the attention of the class while someone else is working it.
10. Many other pupils liked the chart for the same reasons already stated in question 5.

Reasons for dislike of the Electro-Chart:

1. The pictures are too small.
2. You can memorize the location after watching others.
3. It takes too much time.
4. Hard to see from the rear of the room.
5. Your learning is limited, books teach you more.

(2) Teacher Comment--The following remarks were made by the Nature Study teacher who used the Electro-Chart in his classes.

"I have been teaching nature study for three years and during this time I have used the Electro-Chart with my classes. I have found the chart an ever present help and believe my teaching has been improved by the use of it, particularly in the identification of trees, birds, animals, and flowers. In order to prove to myself

whether the chart was of value and not just a game, I tried giving tests to all my classes. The results in classes using the chart at all times were higher. It has been an interest promoter and a source of motivation.

"Many times at the beginning of the periods students would ask, 'Are we going to use the chart today?' They do not seem to tire of it.

"The first and most important matter in nature study is to learn to identify the various plants, birds, and mammals before you can go on and learn about their characteristics, habits, and other interesting details. I consider the chart indispensable in the teaching of nature study. It can well be applied to many other subjects where instant identification is important to learning."

(3) Summary of Results of Questionnaire--In summarizing the results of the questionnaire the following conclusions were reached: 68 enjoyed animal study, while 28 favored bird study; 95 answered that pictures helped them in bird and animal study, and one answered in the negative; 87 would not have enjoyed bird and animal study without pictures and 9 would; 12 stated that the Audubon Bird's Charts made their work more helpful;

8 favored individual flat pictures, and 76 favored the Electro-Chart; 66 did not consider the Electro-Chart just a game but 13 did, and the other 17 considered it a game but an educational teaching device.

The reasons for favoring the Electro-Chart far exceeded the reasons for choosing the Audubon Bird Charts and individual flat pictures. It seems unnecessary to state these again so the author refers the reader to the answers to questions five and seven in this chapter.

CONCLUSIONS

C H A P T E R V I I

CONCLUSIONS AND DISCUSSION

The conclusions in this chapter are based mainly on the results of the study found in Chapter V. All possible elements in the experiment were well controlled except the one element under investigation which was the Electro-Chart. The author again refers the reader to Chapter IV for this information.

(1) Statement of Problem--The problem of this study is: to ascertain whether pupils learn to identify birds and mammals as well by the Electro-Chart as by the lecture method.

(2) Conclusions--From this study the following answers concerning the problem can be listed:

- a. Pupils do learn to identify birds and mammals as well by the Electro-Chart as by the lecture-discussion method. In fact the evidence indicates a strong likelihood that the Electro-Chart is relatively superior in this matter of identification.
- b. The indicated possibility of relative superiority of the Electro-Chart applies to retention of characteristics and related material regarding

birds and mammals as well as to their identification.

- c. More relative superiority of the Electro-Chart was indicated in bird study than in the study of mammals.
- d. Much more interest was indicated in the classes using the Electro-Chart than in the class not using it.

(3) Discussion--The results of this one study are not entirely conclusive but sufficient evidence was accumulated to indicate definite possibilities for the future of the Electro-Chart in nature study courses.

The inconclusiveness of the results are probably due to these factors: (a) the small number of pairs available for the study and (b) the lack of standardization in the tests used. It is evident that further investigation is necessary before a definite answer to the problem attempted is available. Like many other studies of this nature, many more questions are raised than are answered. Among these would be:

- a. Is the Electro-Chart better adapted to some phases of nature study than to others?
- b. Is there any preferred method of using the Electro-Chart for teaching purposes?

- c. Is the increased interest manifested in classes utilizing the Electro-Chart carried over to an increased interest in the physical environment outside of school?

These and other questions of a like nature would have to be answered before full appreciation of the value of the Electro-Chart was possible. It is felt that the results of this study are sufficiently promising to encourage further investigation along the same and related lines.

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A SEGMENT OF THE MAMMAL TEST

A P P E N D I X I

A SEGMENT OF THE MAMMAL TEST USED

Draw A Circle Around The "T" Or "F" Depending Upon Whether
The Statement Is True Or False

- | | |
|--|-------|
| 1. The woodchuck washes all food before eating it. | T. F. |
| 2. Beavers are plentiful in our state. | T. F. |
| 3. The woodchuck is not a good weather prophet. | T. F. |
| 4. There is almost a rat to a person in U. S. A. | T. F. |
| 5. The raccoon was the emblem of the Whig Party. | T. F. |
| 6. The state pays \$10 for the killing of a pole cat. | T. F. |
| 7. The antlers of the deer are shed annually. | T. F. |
| 8. Black bears can climb trees. | T. F. |
| 9. The porcupine kills and lives on small animals. | T. F. |
| 10. The beaver has a soft bushy tail. | T. F. |
| 11. The pole cat and wild cat are the same. | T. F. |
| 12. The chief food of the beaver is bark. | T. F. |
| 13. The weasel is dark brown year round. | T. F. |
| 14. The fox runs in a circle when pursued by dogs. | T. F. |
| 15. The fox is a stupid animal. | T. F. |
| 16. Weasels are very fond of meat. | T. F. |
| 17. The rabbit has long front feet and short hind
feet. | T. F. |
| 18. The fox is one of the dog family. | T. F. |

DRAW A LINE UNDER THE WORD OR WORDS WHICH BEST ANSWERS
THE QUESTION OR COMPLETES THE STATEMENT MADE

1. The mole has (1) no tail (2) a bushy tail (3) a hairless tail.
2. The mole can travel (1) 300 ft. (2) 500 ft. (3) 1 mile, underground in one night.
3. Moleskin is (1) black (2) silvery gray (3) brown.
4. The woodchuck is sometimes called the (1) hedgehog (2) groundhog (3) prairie hog.
5. The fur of the woodchuck is (1) of no value (2) of value for coats (3) of value for brushes.
6. Groundhog day, which legend claims will decide the weather for the next six weeks, comes on (1) April 1 (2) February 2 (3) October 31.
7. The porcupine has quills for (1) defense (2) to keep it warm (3) so it can float.
8. The porcupine throws quills by (1) shaking its body (2) by puffing up (3) by waving its tail.
9. The only animal that can kill the porcupine with ease is the (1) the beaver (2) the weasel (3) the fisher.
10. Rabbit hair is used in making (1) wool (2) felt (3) cotton.
11. The most common rabbit in Agawam is the (1) Jack (2) Cottontail (3) Snowshoe.

FILL IN TEST

Fill in the blank spaces to complete the statement.

1. The porcupine has _____, which they use for protection.
2. Another name for the woodchuck is the _____.
3. The _____ squirrel is smaller than the _____ squirrel.
4. The mother deer is called the _____.
5. The chipmunk has black and light brown _____ on its back.
6. The two most common foxes are the _____ and _____.
7. Because of its short tail, the wild cat is often called the _____.
8. The shepard dog closely resembles the _____.
9. The outstanding colors of the skunk are _____ and _____.
10. The muskrat and _____ have habits that are quite similar.
11. Black rings are found on the tail of the _____.
12. The bat is our only common animal that can _____.

MATCHING TESTS

Match each animal with its characteristic by placing the proper number in front of the statement.

- | | | |
|--------------|-------|---|
| 1. Mole | ..... | Resembles a shepard dog. |
| 2. Woodchuck | ..... | A blood thirsty animal related to the skunk. |
| 3. Porcupine | ..... | Has light brown and black stripes on its back. |
| 4. Rabbit | ..... | Usually travel underground at night. |
| 5. Squirrel | ..... | Has habits quite like those of the dog. |
| 6. Chipmunk | ..... | Appear Feb. 2 to forecast the weather. |
| 7. Fox | ..... | The cottontail and jack are the most common here. |
| 8. Weasel | ..... | Its meat is called venison. |
| 9. Wolf | ..... | Has quills for defense. |
| 10. Deer | ..... | Both the red and gray are good eating. |
| 11. Wild Cat | ..... | Their favorite food is nuts. |
| 12. Skunk | ..... | Related to and closely resemble the weasel. |

THE PUPIL QUESTIONNAIRE

A P P E N D I X I I

THE PUPIL QUESTIONNAIRE

1. Which did you enjoy more, bird or animal study?

2. Did pictures help you in your bird and animal study?

3. Would you have enjoyed your bird and animal study
without pictures? _____
4. Which type of pictures made your work more helpful?
(If any, check your favorite).
 - a. The Audubon Bird Charts _____
 - b. Individual Flat Pictures _____
 - c. The Electro-Chart _____
5. Why did you choose a, b, or c? _____

6. Do you consider the Electro-Chart just a game? _____

7. Tell very frankly what you think of the Electro-
Chart (Either your like or dislike). _____

SAMPLE TEACHER PREPARED UNITS

A P P E N D I X I I I

SAMPLE TEACHER-PREPARED UNITS

1. ROBIN

Color--Reddish brown breast, gray back.

Special--One of the first birds to appear in spring.

Almost four feet of earthworms needed a day to feed a young robin. Word robin is from rubeo, meaning red.

Robin is one of the thrush family.

Habit--Staying around homes, listening for worms on lawns.

Spends the winter in southern United States.

Food--They raid an occasional cherry tree but their main diet is ants and worms.

2. BLUEBIRD

Color--Upper parts and tail blue, under parts reddish brown.

Food--Worms and grubs.

Special--Usually appears in spring shortly after the robin.

Named from his color.

3. CARDINAL

Color--Bright red plumage, black around throat and beak.

Food--Worms and grubs.

Special--Name from crest of feathers on the head appearing

like the cap of a church cardinal. Once killed in great numbers to give the ladies red feathers for their hats.

Once a popular cage bird. St. Louis baseball club named after this bird. Easily recognized by crest of feathers on the head.

4. HOUSE WREN

Color--Upper parts cinnamon brown with blackish bars, underparts white.

Food- Caterpillars, spiders and grasshoppers.

Special--Very fond of houses such as tin cans, old shoes, coat pockets and bird houses. They usually perch and chirp with the tail erect.

1. MOLE

Length--6"

Color--Silvery gray

Home--A nest and tunnels 5 to 6 feet under ground.

Fur--Short, soft, and quite valuable.

Description--No external ear, tiny almost invisible eye, large front feet for digging, tiny hind feet. Hairless tail.

Food--Earthworms and insects. They will attack birds, frogs, snakes, and lizards.

Special--Can travel 300 feet under ground in one night.

If deprived of food for 10 or 12 hours they will die.

They are good swimmers. They depend on smell and touch rather than vision.

2. WOODCHUCK

Length--About 18"

Color--Yellowish gray and black hair.

Home--Tunnels, leading to a chamber 4 to 5 feet under ground.

Fur--Of no value. Hide was once used for leather.

Description--Short legs, long hair, fat body, weight 8 to 15 pounds.

Food--Mostly clover and vegetables.

Special--Sometimes called the groundhog. Poor climbers and swimmers. Home range 100 yards. Good eating if properly prepared. The tunnels leading to the den of the woodchuck often break the legs of horses and cattle. They belong to the squirrel and rat family. Hibernate from Sept. to March 5. 5 to 6 young are usually born about the last of April. Groundhog day originated in Germany only it was the bear that came out Feb. 2 to forecast the weather.

3. PORCUPINE

Length--18 to 25"

Color--Dark brown and black, quills tipped with yellow.

Home--In hollow logs and pine and hemlock trees.

Fur--Of no value.

Description--Body covered with quills or needles.

Food--Bark and twigs, they are very fond of salt.

Special--Called the slowest and most stupid animal of the woods so they have quills for defense. They throw quills by waving the tail. Sometimes called the hedgehog. They are good to eat. Home range about 2 acres. Hibernate as little as possible. One to four young usually are born in May. They float very well because of quills. The fisher is the only animal that kills it easily. Protected in some states.

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